Ceramic Springs, Phase I

Completed Technology Project (2018 - 2019)

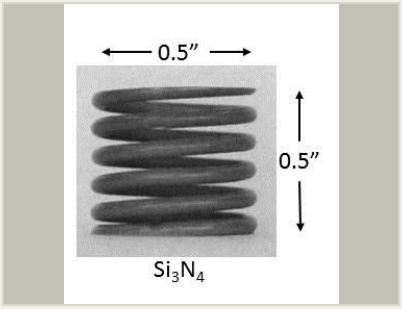
Project Introduction

Hypersonic aircraft, especially reusable hypersonic aircraft, require advancements in high temperature materials because of the extreme temperatures resulting from frictional heating. One aspect of this problem is making seals that can function through a very large temperature range, perhaps up to 1000 C or higher. Metallic springs essentially lose their ability to function at 600 C or below. Ceramic springs, principally made of silicon nitride, are capable of functioning throughout that temperature range, but lack the strength required for most applications. They also undergo very limited deformation before failure. TDA will improve the feedstocks and modify the existing process for manufacturing ceramic compression springs. Through improvements to the grain structure, the resulting springs will overcome their previous limitations.

Anticipated Benefits

Ceramic compression springs are primarily being developed so that high temperatures seals in the (sc)ramjet engines can be preloaded. However, the high temperature – capable springs could also solve problems in the control surface and/or leading edge thermal protection system. These needs are particularly acute for re-usable hypersonic transports, including the descendants fo the National Aerospace Plane.

There will be many uses for these high temperatures outside of NASA. Most obviously, certain (single-use) air-breathing hypersonic weapon systems have the same needs as NASA. However, the chemical resistance and high temperature stability of ceramic springs will allownew sealing options in a wide variety of industrial processes. Ceramic springs that allow seals to be made between smaller, simpler pieces of tooling can cut manufacturing costs by obviating the need for larger more complex tooling.



Ceramic Springs, Phase I

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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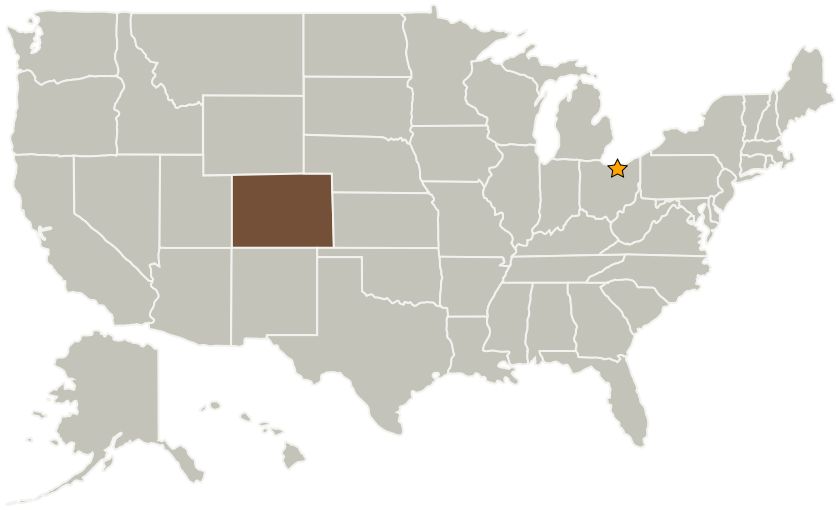
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
TDA Research, Inc.	Supporting Organization	Industry	Wheat Ridge, Colorado

Primary U.S. Work Locations
Colorado

Project Management

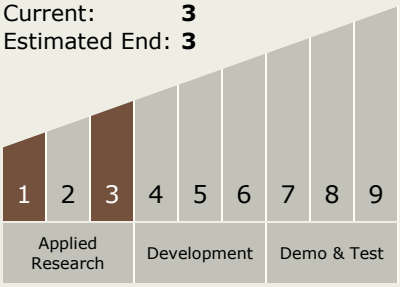
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Michael Diener

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.2 Avionics Systems and Subsystems
    - TX02.2.9 Hardware Enabling Secure Avionics

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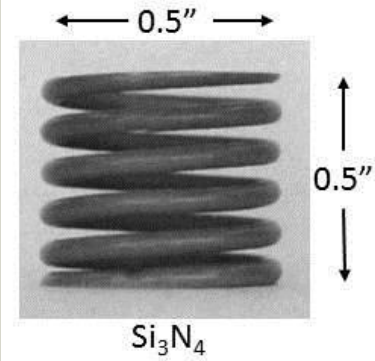
Images



Project Image
(https://techport.nasa.gov/image/34782)